New Technologies for Challenging Workpieces

EMAG OFFERS TURNING, MILLING AND GRINDING SOLUTIONS

The ever-increasing demand made on precision components as well as the decrease in price is pushing traditional manufacturing processes to their limits. In recent years, EMAG LLC has been working on new production technologies that will complement or replace traditional processes such as turning, milling and grinding. These new technologies will be featured at IMTS (September 10–15) in Chicago later this year.

PECM FOR NICKEL- AND TITANIUM-BASED ALLOYS

With its PECM (Precision Electro-Chemical Machining) technology, EMAG presents a production process that opens up entirely new fields of application. PECM is a process for the machining of high-alloyed materials, such as nickel- and titanium-based alloys. The disadvantages of traditional metal cutting—tool wear, mechanical stresses, micro-fissuring caused by heat, oxidization layering and the need for subsequent deburring operations—are eliminated, as this process is a non-contact one without heat input. All electro-chemical machining processes are characterized by stress-free material removal, smooth transition points and surfaces without ridge formations.

"Many of our PECM customers are eliminating the traditional steps in the machining process, such as milling, turning, drilling, etc. and replacing them with one technology using PECM," says Peter Loetzner, CEO of EMAG. "In situations where customers are doing near-net shaping, the customers changed from forging parts to using the PECM process to machine the shape and finish (polish) the workpieces in one step. If they don't have near-net shaping, we are doing roughing with ECM. When they are finished, the workpieces have a very fine surface and geometry."

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The advantages that the PECM process provides for a number of different branches of the industry are best shown on the example of a turbocharger for the automotive industry. The electro-chemical process is one that can be used effectively in the machining of many high-alloy components, especially those in the high-temperature sector of the turbocharger. It also offers a much shorter and very efficient process chain. The kind of downstream clean-up operations necessary when traditional machining processes are used—such as deburring after milling—are no longer necessary. PECM machining operations are burr-free. And there is hardly any tool wear. The result: downtimes are minimal, when compared to milling (which requires regular tool changes). The process as a whole is sturdier and less prone to errors. And another important factor that our example of the turbocharger shows: the superb surface finish of the PECM process, where Rz values of 0.3 micron can be achieved."

"Since the process started, we have learned a lot about different types of

continued

materials," Loetzner says. "For example, there is a big influence in what direction an alloy is forged or produced. We also learned about how to protect a workpiece and how to get the best result through pre-cleaning and after cleaning. It is sometimes very tricky to polish a specific material these workpieces are made out of, and with ECM and PECM we are able to achieve better accuracy and durability using different fluids. For example, some with higher amps or more connectivity. We learned a lot about the final details which end up influencing the entire process."

One of the industries that EMAG believes would definitely benefit from ECM and PECM is the aircraft/aerospace industry. "In this industry they are machining a lot of parts out of Inconel, titanium alloys and nickel-based alloys," Loetzner says. "The big benefits come with these alloys because they are difficult to machine with traditional technologies, there are huge costs and a lot of tool wear. With ECM and PECM technology there is no wear—so no tool wear and so no tool cost. I think that this technology will break through in the aircraft industry in the next 2 or 3 years due to the major benefits the technology brings."

Precision Electro-Chemical Machining (PECM) is eliminating traditional steps in the machining process such as turning, milling and drilling (all photos courtesy of EMAG).

REDUCING OPERATING COSTS BY 50 PERCENT

Production laser welding is already a highly productive process in the manufacturing of gear wheels. The use of diode-pumped solid-state lasers—such as disc or fiber lasers—reduces operating costs by up to 50 percent. "Production laser welding has led to a significant reduction in the cost to customers as well as the reduction in capital investment in the manufacturing process of gear wheels," Loetzner says. EMAG has been involved with the use of solid-state lasers in the welding of powertrain components from an early stage and is considered a pioneer in the technology. EMAG again

has fulfilled a promise to their users of offering them the lowest possible cost-per-piece, by coming up with an innovative technology that brings true cost benefits.

For many applications, solid-state lasers allow welding without shielding gas. This not only reduces operating costs, it also avoids having to follow the annoying logistics imposed by the use of shielding and laser operating gases. In many cases, the welding process can also be sped up considerably. This increases productivity and—through a reduction in energy input per unit length—reduces welding distortion, resulting in better component quality.

SINGLE PIECE CAMSHAFTS?

Another highlight is EMAG's heat-shrink assembly technology, a process that scores particularly well in camshaft production. The high degree of precision achieved with the joining process drastically reduces the number of cam profile grinding operations or—with the use of precision cams—avoids them altogether. Another benefit of the process is the ability to combine different materials in the construction of the shaft, such as forged cams (e.g. in 100Cr6) and sintered cams, which do not require regrinding. Accessory components, such as plugs and end pieces, can—like the shaft itself—also be made of better materials. This allows for the camshaft to be adapted to the requirements of the engine and to be optimized in load bearing capacity and manufacturing costs.

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Ticona

OFFERS INTEGRATIVE SIMULATION TECHNOLOGY

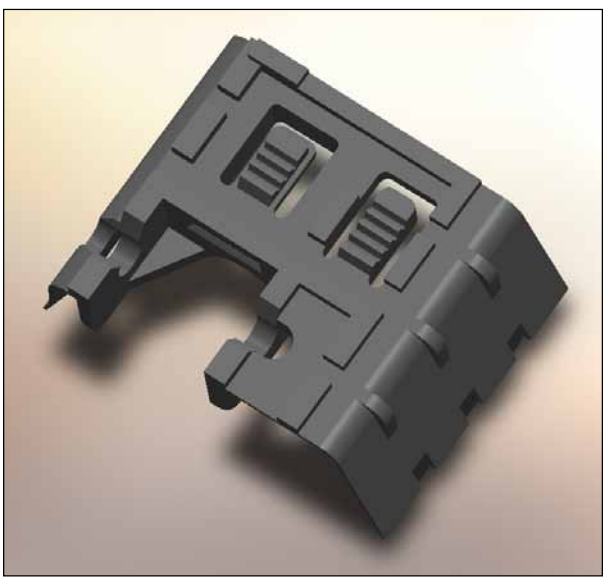
Ticona Engineering Polymers has announced the global availability of "integrative simulation" technology that can help customers design cost-effective complex glass fiber reinforced parts. "As a solution provider, Ticona recognizes that successful new components rely on the speed and quality of computer-aided engineering (CAE) predictions," said Ulrich Mohr-Matuschek, Ticona global part design/CAE leader. "Customers today expect working solutions based on detailed structural response predictions and optimized mold design."

Since 2009, Mohr-Matuschek and his team have worked with e-Xstream engineering Digimat material and structure modeling tools to link Autodesk *Moldflow* plastic injection molding simulation tools with Ansys Inc. structural analysis to improve the accuracy of computing fiber reinforced components under load. Labeled integrative simulation, because it integrates processing simulation data in the computation of the component, this technology can be used in designing complex parts that use both short- and long-fiber reinforced thermoplastics.

"By systematically comparing simulation and experimental results, we have shown this procedure can move simulation forecasts a lot closer to the actual experimental gradients," Mohr-Matuschek said. "Thus, the non-linear and anisotropic simulation of a sunroof mount made with a glass fiber reinforced Celanex thermoplastic polyester (PBT) matches the experimental values a lot better than the results of other computation models."

FIBER FLOW ORIENTATION KEY TO SUCCESS

The field of application for fiber reinforced thermoplastic polymers is constantly increasing, especially in parts exposed to high loads. Cost and time factors are issues that have played a significant role in increasing the relevance of CAE in part design. Standard procedures, based on the finite element (FE) method, are frequently used. Numeric methods provide information on the component's behavior under load assuming uniform mechanical properties of the molded material. However, mechanical properties of fiber reinforced thermoplastics vary depending upon the orientation of the fibers. During the mold filling phase of the injection molding process, the fibers typically are oriented in different directions within the part as a function of the melt flow. The influence of this local fiber orientation is substantial



Ticona used "integrative simulation" technology to help Inteva Products - Roof Systems Germany GmbH in analyzing the design of a sunroof mount molded from glass fiber reinforced Celanex thermoplastic polyester (PBT).

and not taken into account in the common numerical methods, a factor which plays a significant role for components subject to high or extreme loads.

Unlike standard FE calculation methods, integrative simulation takes into account the influence of the local fiber orientation in the component as well as the elastic-plastic behavior of the matrix materials. Non-linear anisotropic material models are used for this method. Models are based on stress/strain curves that are determined on specimens of the specified material in the main orientation direction of the glass fibers, at a 45-degree angle and perpendicular to the main direction. The results for the fiber directions are transferred after the mold filling simulation via so-called "mapping" to the structural analysis.

VERY GOOD APPROXIMATION OF GRADIENT

Ticona applied the integrative simulation for the design of a glass fiber reinforced sunroof mount made of Celanex 2300 GV1/30 PBT and examined the results in terms of accuracy in comparison to experimentally determined values. "This is a great example of an effective joint project with one of our customers, Roland Peter, manager simulation & analysis, Roof Systems, Inteva Products in Germany," Mohr-Matuschek added.

The systematic comparison of this non-linear anisotropic simulation displays a considerably improved compliance with experimentally determined values. The resulting simulation for the sunroof mount illustrates that the integrative simulation provides more accurate results than common linear isotropic calculation methods. "Our integrative simulation is an effective technology for the optimal design of a fiber reinforced component and offers major advantages in material savings and cost in complex parts," said Mohr-Matuschek. "Integrative simulation demonstrates the tools Ticona can deliver in helping customers to design components and underscores its position as a solutions provider in the field of material, component design and processing."

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Drake

SHIPS THREAD GRINDERS TO CHINA

Drake Manufacturing Services Co. has recently shipped two linear motor 4-axis CNC thread grinders to a Chinese petroleum company manufacturing drilling rigs, pumping units and other oil field equipment. The first machine, a Drake GS:TI-LM 650 High Accuracy Internal Thread Grinder, will grind threads on ring gages for checking API threads. The second machine, a Drake GS:TE-LM 650 High Accuracy External Thread Grinder, will grind threads for API plug gages. Drake fitted the machines with CNC contour dressers for creating complex wheel forms including all API, full radius and gothic arch, acme with crest and root radii or chamfers, as well as a 60-degree buttress and other thread forms. Both machines were programmed on the customer's parts and proved out at the Drake factory in Warren, Ohio, prior to shipment. Changeovers can be accomplished in as little as 15 minutes by simply entering new part parameters into the Drake *PartSmart* menus in the Fanuc CNC. The machines will be installed by Drake service engineers, and ongoing service will be handled by local trained field service technicians.

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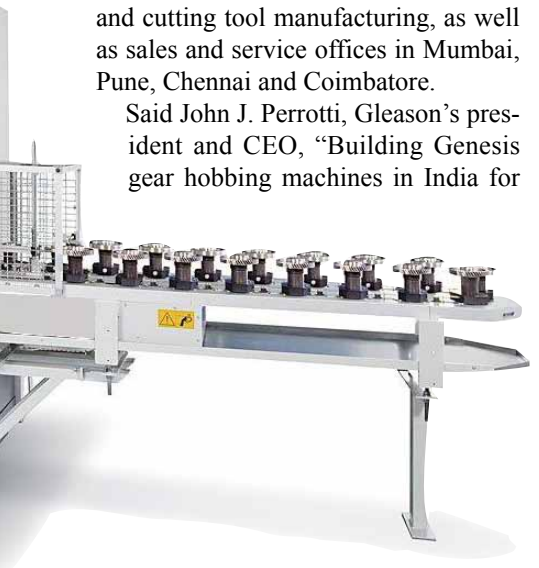
Gleason

BUILDS GENESIS SERIES IN INDIA

Gleason Corporation recently announced that they have started building their highly popular Genesis series of gear hobbing machines at their Gleason Works (India) facility in Bangalore. The Genesis models 130H and 210H hobbers are being built for the fast-growing Indian market using the same high-precision components as with Genesis machines built in other locations. The 210H machine accommodates gears up to 210 mm in diameter, including those with shaft lengths up to 350 mm. Features include Siemens 840D controls, integrated chamfering and deburring, and a high speed loading system to reduce load/unload cycles to a minimum. Gleason already builds the Genesis series of gear hobbing machines at facilities in the U.S., Germany and China.

The Genesis 260H and 400H, which was introduced at the EMO in September 2011, will also be built in India at a future date. Supporting the entire Genesis line of gear hobbers in India is an array of cutting tools, including high speed steel and carbide hobs, as well as an existing tool sharpening service. Gleason already has a presence in Bangalore for sales, service and cutting tool manufacturing, as well as sales and service offices in Mumbai, Pune, Chennai and Coimbatore.

Said John J. Perrotti, Gleason's president and CEO, "Building Genesis gear hobbing machines in India for the Indian market is a logical extension of the strategy we embarked upon several years ago. We have for many years been rebuilding gear production machines at our Bangalore facility and have developed a competent staff and the necessary skills to smoothly transition to successfully building our leading line of gear hobbers. Global auto and truck companies, both domestic and foreign-based, are expanding their operations in India, and are eager for us to expand our local manufacturing footprint in this growing region."



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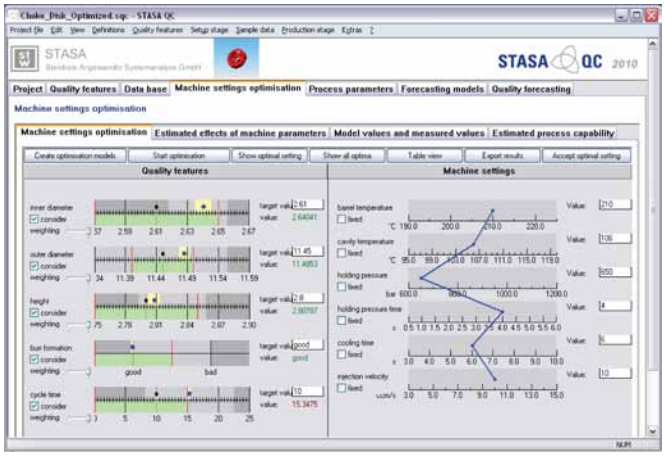
Kistler

INTRODUCES INJECTION MOLDING SOFTWARE

Kistler North America, a worldwide supplier of precision sensors, systems and instrumentation for the dynamic measurement of pressure, force, torque and acceleration, has announced the global market introduction of its industry exclusive *STASA QC* plastics injection molding process optimization software. *STASA QC* is expressly designed to optimize the machinery parameters, including process stabilization, shortened cycle times, and production efficiencies, most critical to zero-defect medical, automotive, electrical component, optical, and LSR plastics injection molding operations.



Traditional injection molding machinery optimization involves time-consuming, manual "trial-and-error" adjustments of relevant parameters until all quality targets are met. During this phase, user experience with similar parts, materials and injection molding machinery is critical. Online process optimization (i.e., during active production) is even more complex, as each parameter change can mean new machinery setting modifications, cycle time data recording and molded parts measurements. Due to post-production shrinkage or water absorption, parts can take several days to be ready for use, often first requiring time-consuming readjustment of machinery operating points, creating costly downtime.

STASA QC is based on a repeatable systematic design of experiments (DOE) method for determining best machinery setting operating points, as well as online processes. With user-selectable parameters, such as holding pressure levels, injection speed and others, *STASA QC* recommends a number of experiments, allowing for a setter to change or enhance a selection as needed. The DOE methodology

allows for machinery behavior simulation and visualization, preventing unnecessary experiments. All parts created from these experiments and their associated geometries are analyzed to determine best machinery settings. All mathematical calculations occur in the background, with a minimum number of tests required to run at various parameter settings.

During a typical *STASA QC* simulated injection molding process, experiments are carried out on a PC, with parameters that can be changed interactively by the clicking and dragging of a mouse. The effects of these changes on each quality feature can be tracked on-screen, without doing so on the injection molding machine. This is of benefit, particularly for the online optimization of active production processes. *STASA QC* has an integrated report feature for protocols that provides an end-to-end documentation of the setting procedure and all optimization results. Resultant measurements from these experiments are imported into *STASA QC* for proper system storage of required dimensions and variations, as well as attributive part features for each machinery setting. It also verifies potential processing capability of a defined setting. By using this data and applying innovative data-based modeling methods, *STASA QC* identifies a precise correlation between machinery setting and part quality. With the help of this correlation, the software determines the ideal point and setting at which the machine meets set quality requirements, taking into account statistical fluctuations of part dimensions. The best machinery operating point is one that is producing the fewest defective parts. At the same time, *STASA QC* automatically determines the effects of machinery settings on individual part quality features.

New Kistler *STASA QC* software offers lower overall production costs, with shorter cycle times, fewer defective parts and greater ability to accurately forecast parts processes; faster production start-up; fewer required experiments; safer injection molding processes; more stable and continuous zero-defect parts production; fewer required readjustments during large-scale production processes; and more readily available, accurate process information, with fully reproducible and recordable results.

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Allison Transmission

PURCHASES GRINDING CELL FROM C&B MACHINERY

Allison Transmission, which manufactures commercial-duty automatic transmissions and hybrid propulsion systems for truck and off-road vehicle manufacturers, has ordered another new grinding cell from C&B Machinery. After multiple machine orders for a plant in Chennai, India, they are bringing this same technology to the United States. C&B Machinery develops and builds grinding systems for manufacturers around the world; in this case, it will build a "flexible" double-disc grinding cell for Allison Transmission in Indianapolis.

The new cell is designed to grind the faces of transmission pinion gears for Allison's 3000 series transmissions. This machine will be set up to grind three different pinion configurations, flexible for future expansion and any future part program changes. The grinding cycle time for a finished part will be 15 seconds.

Double disc grinders remove an equal amount of material from both faces, simultaneously. The new machine performs a "rotary plunge" grinding cycle, which means the pinions are introduced to the grinding wheels via a rotary carrier, one at a

time, while the grinding wheels plunge grind simultaneously through axis interpolation. There are several advantages for grinding in this manner, the most important of which is the grinding wheels are adjusted perfectly parallel and concentric to each other. Most often, conventional double-disc grinding requires compound head settings. Keeping the wheels parallel results in a more uniform wheel wear and it reduces the frequency of dress cycles required. The cost per piece is reduced and the return on investment is faster.

This grinding cycle was developed by C&B Machinery engineers. In addition to the operating and investment cost savings it allows 100 percent gauge feedback on every component ground. Size control is tightened, resulting in higher statistical capability.

For example, the grinding cells previously shipped by C&B far exceeded 2.0 ppk in overall height (±0.030 mm) and parallelism (0.026 mm).

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Star SU

TOOLS OFFER ADVANCED COATINGS

Balinite Alcrona Pro, the second generation of AlCr-based coatings, is now available on new and re-sharpened tools from Star SU. Developed by Oerlikon Balzers, Alcrona Pro can be used in a wider range of applications than other aluminum-based coatings because it provides better heat resistance for high temperatures and better wear resistance for tough cutting applications. Lower thermal conductivity allows Alcrona Pro-coated tools to work well in low temperature applications and allows faster hobbing speeds; 200 m/min is the new base speed. The cost savings include 30 percent lower tool costs, 50 percent longer tool life, 20 percent faster cutting parameters and 100 percent dry cutting. These tools will be on display at IMTS 2012 (September 10–15).

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Mazak Integrex

COMBINES VERSATILITY AND HIGH ACCURACY

The Mazak Integrex i-200ST Multi-Tasking machine efficiently processes mid-size complex components. It offers versatility and high accuracy in a compact design as well as features twin spindles, a lower turret and milling spindle for unbeatable Done-In-One productivity. As a Level 4 machine in Mazak's Five Levels of Multi-Tasking, the Integrex i-200ST turns, drills, taps and mills, while offering off-centerline and full simultaneous 5-axis contouring. Mazak developed its Five Levels of Multi-Tasking as an effective way for manufacturers to determine the best multi-tasking technology for meeting their specific application and process needs.

Both turning spindles on the Integrex i-200ST provide equal high performance with spindle speeds of 5,000 rpm and C-axis turning control. And both have a bore capacity measuring 3" (76 mm) in diameter. For C-axis contouring versatility at either turning spindle, the i-200ST vertically mounted milling spindle provides 30 hp (22 kW), 12,000 rpm and a rotating B-axis range of –30 to +240 degrees. Mazak's unique roller cam drive for the B-axis ensures higher accuracy and rigidity, while providing zero backlash. A 36-tool (72-tool optional) magazine allows for fast tool changes and provides ample tooling for continuous part processing.

The lower turret on the Integrex i-200ST model comes standard for nine turning tools. The lower turret working in combination with the machine's milling spindle that can be applied to either side of the machine headstock reduces machining cycle times. Mazak incorporates its MX Hybrid Roller Guide System into the Integrex i-200ST for durability and reliability that result in long-term accuracy. The MX Hybrid Roller Guide System dampens vibration to extend tool life, handles higher load capacities, accelerates and decelerates quicker to shorten cycle times, consumes less oil for "greener" operations, and lasts longer with less required maintenance.

For a compact multi-tasking center, the Integrex i-200ST provides an ample Y-axis travel of 9.8" (249 mm) and vertical X-axis of 24.2" (615 mm), with 4.92" (125 mm) below centerline. The machine accommodates parts up to 25.9" (657.8 mm) in diameter. And because its tool magazine is located at the front, machine operators can do programming and tool setup with minimal required movement. Additionally, all machine lubrication points and gages are gathered into a single panel for ease of viewing and maintenance.

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